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The Whole Truth—Not Selected Truth

R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

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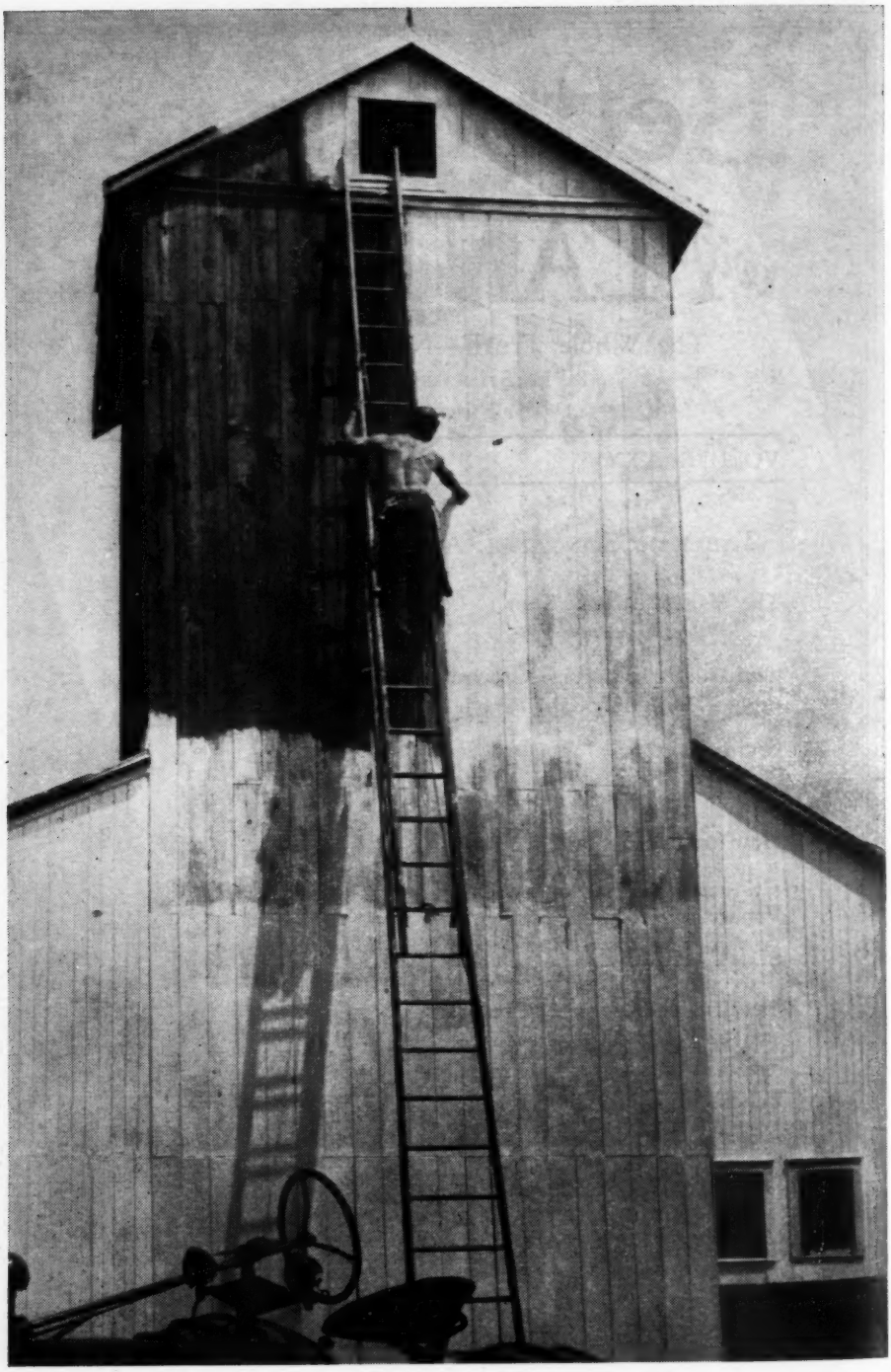

A Need for Proper Balance

Better Crops with PLANT FOOD

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VOL. XXXV WASHINGTON, D. C., AUGUST-SEPTEMBER 1951 No. 7

Nowadays It Is . . .

The Man With the "Know"

Jeff McDermid

GONE forever are the days of yore when Edwin Markham's famous poem of satisfied and dullard rural life brought out the painting of a weary peasant leaning with resignation on his hoe. "The Man With the Hoe" caused no end of controversy on and off the farms. There was just enough stark truth about conditions in rural America then to furnish the basis for pros and cons to argue whether our producers were sunk in frustrations and low in morale. Since the turn of the century when these debates were rife, the change in farming and rural living has been so sweeping and complete that such old theories and fears no longer have much excuse for existence—except in a minority of our most backward zones.

People were dubious, however, as to whether agricultural expansion could continue after the free homestead land offered by the benevolent Government was entirely gone. If farmers were to be limited in their power to produce by the comparatively crude equipment and haphazard methods in vogue about 1900, it was doubted that the rapidly growing population could be adequately fed by the 33 million persons working the land at the time. But now we have 24 million farm folks generally able to produce plenty and some to spare for over six times their numbers—and sometimes raising cane and election chatter about supporting prices on a burdensome surplus.

Poor land and uncertain weather, hordes of noxious insects and troublesome weeds, insidious livestock diseases, lack of sufficient power for field jobs in all seasons, guesswork and superstition—these handicaps were then accepted as part of the inevitable lot of the tanned and toughened farmer. Nobody ever imagined that poor land sometimes made good land or that weed battles could be won easier than by hoeing; and few believed that science might even work out ways to get around many of the worst weather hazards through soil management and plant breeding.

The marshalling of scientific knowledge put to practical use right on the farm has, of course, been the real answer to this vast improvement—so marvelous that only we who lived in the dismal and deprived era can really grasp its full significance.

IN former times farmers noticed that certain varieties or strains of plants invariably did well, and exceeded the average run raised in their communities. The natural thing was that all of the farmers within earshot, and often those in distant states, sought the source of the new and better plant or variety. No thought was given as to whether latitude or climate or soil treatment or other factors combined to make such plants do better than others. Hence there were some big disappointments when a much touted specimen failed to live up to its lurid claims in some place other than where it first demonstrated its superiority.

This led men to ponder as to the advisability and usefulness of tests and trials carefully handled at more than one location. Here was the nub of the idea that finally led us to pass legislation enabling states to create agricultural experiment stations, linked eventually with each other and with the federal scientific staffs.

It is now just 50 years since the last step was taken in the field of plant physiology, wherein about a dozen state experiment farms signed up to conduct a series of investigations in cooperation with the, then, newly created Bureau of Plant Industry and the Bureau of Soils. B. T. Galloway was the first director of this effort, and he had only about forty persons on his staff, with the scene of activity lying southwest of the Potomac river at Arlington Farms—now the site of the gigantic Pentagon building.

It was not long thereafter until the old States Relations Service came into the picture, because scientific men—however much they are often criticized for lack of "farm sense"—believed that pure science begets applied science, and from here it is a logical step to enlist dirt farmers in the proving-up process and the practical use of the discoveries. In a few years the Extension Service succeeded the States Relations staff, and soon thereafter the Office of Experiment Stations forged the machinery for tying up the rapidly expanding sources of farm achievements in new fields.

WHEN a large group of our present-day leaders of agricultural research meets at Beltsville, Md., this year to notch the milestones of our wonder era, they will traverse old ground and check over the outstanding discoveries and adaptations which were charted in the books of plant history. When we recall that the plant realm is only one segment of the entire complex cosmos that gives life and meaning to agriculture, we realize how vast and inter-related must be the continuing work of all our busy delvers in farm advancement.

Only a few months ago, at the request of Congress, a hefty set of reviews and historical papers on the achievements of agricultural and related research was printed—in three volumes, I believe. Not only are these books of great permanent value, but they show the tremendous scope of the tireless and enthusiastic army of devoted scientists who have pledged their

lives to fitting small pieces into a gigantic puzzle picture, only a fairly good corner of which can now be seen and appreciated. Credit for all that such publications reveal to those who have the time to scan them belongs to the scientists first and foremost—but with

painstaking and trained information personnel contributing indisputably to their ultimate worth and usefulness.

I say that it is high time for the farming world to eke out a modicum of praise and thanks to the "translators" and readability molders, the good storytellers and word-painters who go alongside the extension forces in popularizing and interpreting so many topics that otherwise stir up dust and make folks yawn.

It is not always thus. Too often we dish up far too much jargon of the laboratory for publications mainly intended for creating favorable opinion and positive action. You can't blame the chemist or the physicist for wanting to spread his formulas and definitions, but everything has its proper place. Unless men understand, they go to sleep and forget.

RETURNING to the main stem of the plant diorama which began to grow and prosper soon after 1900, we can call the roll of positive annual revelations which had their genesis in this cooperation of farm and state and federal government. And always the crossroads forum and the excited and zealous extensioneer furnish scenes that no film record of progress may overlook.

Ladino clover was brought from Italy in 1903. Tung trees came from plant explorers in China in 1904. Dryland and irrigation research got its feeble start in the Great Plains stations in 1905. In that year the first report was filed on a cross involving inbred strains of corn. The Dillon variety of cotton, resistant to fusarium wilt, was perfected for planters.

The year 1908 saw further varied progress. Introductions from Asia led to the establishment of a thriving domestic date industry here. Yuma, an American-Egyptian cotton, as well as Acala cotton from Mexico, were first developed. The wild plantations of blueberries, long sought by the settler and the red man, were caught in the net of improvement.

Pre-cooling fruit for overland shipment, white pine blister rust discoveries, and the famous Hegari grain sorghum imports from Africa labeled 1909 as eventful. In 1910 Ladak alfalfa came over from India. In 1911 the cotton growers started their now famous and successful community betterment program—and it was in that same year that research began on the resources for potash fertilizers here.

Momentous advancement marked 1914, when the fixation of atmospheric nitrogen for fertilizer had its inception in cooperative and industrial research and tests.

Again, in 1915, there came to light the new concept worthy of a gospeler—that soils are living organisms, not inert and supine matter. New ideas were tested which exploded the once sturdy belief that dust mulch and capillary action governed everything in soil treatment.

Just a bit later, in 1917-18, the science of the "plant doctors" had gone far enough to make it feasible to set up competent field aides and observers of plant diseases. This led to the initiation of the valuable plant-disease survey system—still open for further perfection. Great new gains were made in

(*Continued on page* 40)

Orchard Fertilization—
Ground and Foliage

By J. R. Magness

Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Md.

SUPPLYING the orchard tree with essential nutrients differs in a number of respects from fertilizing annual crops. In the first place, the tree grows in one location for 15 to 50 or even more years and thus it is possible, if we know the nutrient supplying level in a particular soil, to plan long-range fertilizer treatments. Also tree roots take in nutrients through much of the year. When these nutrients are not being utilized in the formation of new tissues they are stored and are then available to the tree during periods of rapid growth. Roots of mature trees occupy large soil areas and may obtain sufficient quantities of certain of the nutrient elements for optimum growth and fruiting where these same elements would be insufficient for rapidly developing annual crops.

We should keep in mind that the purpose of fertilization is to increase the quantity of the nutrient elements not supplied by the soil in sufficient amounts to promote optimum growth and fruiting. Nutrient elements are present in varying amounts in agricultural soils. Some agricultural soils may supply sufficient quantities of practically all nutrient elements for satisfactory tree growth and fruiting. Other soils may be deficient in the available quantity of a number of elements. When we consider fertilizing the orchard, therefore, we must always keep in mind that the purpose is to add the nutrient materials that are not supplied by the soil in sufficient quantity for the needs of the trees. Usually these materials are applied to the soil, but some may also be supplied to the tree by spraying or dusting them onto the leaves.

We often speak rather loosely of a complete fertilizer, meaning one containing nitrogen, phosphorus, potassium and possibly magnesium. These, however, are only three or four very important elements of the 14 which we now recognize as absolutely essential for the development of any fruit plant. Let us consider these 14 elements and their role in orchard fertilization.

Three of the 14 elements are not obtained by the plant from the mineral or organic part of the soil. One of these, carbon, makes up the great bulk of the plant and is obtained from the air in the form of carbon dioxide. The composition of the air cannot be modified appreciably. The quantity of carbon dioxide which the plant can obtain from the air is determined by the extent of the leaf system. Sunshine is necessary for the building of the carbon compounds in the plant. So far as orchard production is concerned the limitation of carbon building is likely to be due to lack of sunshine and an insufficient or unhealthy leaf system rather than to insufficient carbon dioxide supply. Lack of sunshine may often be limiting in humid, cloudy areas such as our eastern growing districts.

The two other elements important in plant nutrition not obtained from the mineral or organic part of the soil

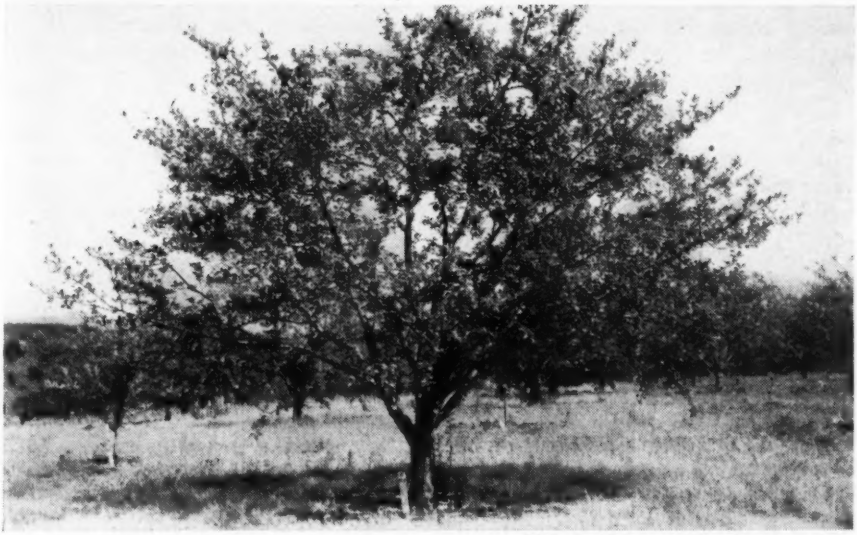

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 1. York Imperial apple tree growing in potassium and magnesium deficient soil and fertilized with nitrogen only—Plant Industry Station, Beltsville, Md.

are oxygen and hydrogen. These are derived mainly from the breaking down of water in the photosynthesis process. So long as the plant has water there is no shortage of these elements, at least for direct nutrient use. Lack of oxygen in the soil may result in injury to the roots and unsatisfactory

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 2. York Imperial apple tree growing in potassium and magnesium deficient soil and mulched annually for three years with 200 lbs. of orchard grass hay previously fertilized with NH_4NO_3 at rate of 300 lbs. per acre. Nutrients released from the mulch each year were as follows: N 1.14 lbs., K 2.93 lbs., P .28 lb., Ca .17 lb., Mg .15 lb., B .002 lb., Mn .006 lb., Cu .0009 lb. Note unmulched tree in background left—Plant Industry Station, Beltsville, Md.

root growth, particularly if soils are full of water, but there is no lack of oxygen in the tree for direct nutrient use so long as moisture is present.

Thus only 11 of the elements known to be essential to plant growth are obtained from the mineral and organic components of the soil. Six of these are often referred to as major elements, while five are classed as minor. This classification refers to the quantity of these elements required for optimum plant development. It does not mean that one group is more or less essential to the functioning of the plant than the other. A minor element that is in short supply may be just as disastrous in its effect on the plant as a so-called major element that is deficient. The following paragraphs give an indication of the relative quantities of these elements present in the leaves of a well-nourished fruit tree. By well-nourished we mean trees that are making ample growth and that are not, so far as can be determined, lacking in any nutrient element. We give the elements in parts per million based on the dry weight of the leaves in order that the quantities may be readily compared. The quantities of these materials present in the leaves are closely correlated with the relative quantities that the tree crops require. These amounts vary somewhat with different kinds of fruit crops but those given form a general background of the nutritional requirements of orchard trees in general.

Major Nutrient Elements

Nitrogen—Nitrogen is generally present in the foliage of fruit trees in larger quantities than any other of the mineral elements with the possible exception, under certain conditions, of potassium and calcium. Fully developed leaves of most fruit trees in well-nourished condition contain 20,000 to 25,000 parts per million of nitrogen when sampled in midsummer. Only the strongest orchard soils maintained under cultivation, or under a mulch of organic matter, supply this quantity of nitrogen without supplemental fertilization. Practically all orchards in the United States require supplemental nitrogen for optimum growth and production.

Potassium—Potassium ranks a little lower than nitrogen in the quantity present in the foliage. With most fruit trees a level of about 12,000 parts per million, or above, in the foliage means that the tree is amply supplied with potassium. In many orchards where there is an abundant supply of potassium available to the tree, the level may be as high as 18,000 to 20,000 parts per million. In many orchard areas, trees are able to obtain abundant quantities of potassium from the soil without supplemental fertilization. There are, however, a number of areas where potassium is generally low and supplemental potassium feeding is therefore essential for optimum production. That condition is general along the Atlantic Coastal Plain from New England down through New Jersey, the Carolinas, Georgia, and Florida and in the Coastal Plain along the Gulf Coast. In other areas of the country the situation is much more variable. Many orchards are in the luxury range so far as potassium is concerned in that the soil supplies more potassium than the trees can possibly use. However, in many sections there are individual orchard soils which do not supply the full potassium requirements of the tree. Fortunately, we have in leaf analysis a method of determining what the potassium situation is in a particular orchard. By making chemical analyses of the leaves taken under proper conditions it is possible to determine the level of potassium as well as of other elements. If the potassium content is less than about 12,000 parts per million, or 1.2 per cent, the orchard is at least near the point of insufficient potassium supply. If the content is well above this figure the trees are obtaining the potassium they need from the soil and no benefit would be expected from supplying additional quantities.

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 3. Potassium deficiency, Elberta peach, fertilized with only $NaNO_3$.

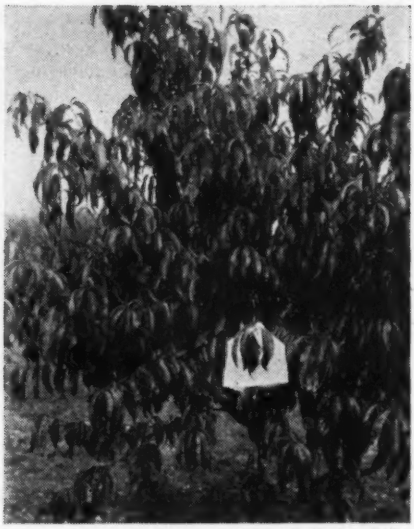

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 4. No potassium deficiency, Elberta peach, fertilized with KNO_3.

The use of leaf analyses is discussed further under the heading "diagnosing nutrient deficiencies."

Calcium—The quantity of calcium contained in fruit tree foliage is about the same, or a little higher than that of potassium. It generally runs 15,000 to 25,000 parts per million. So far as we know, direct calcium deficiencies for the growth of trees are rather rare. Calcium in the form of lime is used to correct excessive soil acidity and promote the growth of cover crops rather than to supply calcium to the trees. It is possible, however, that under some conditions, particularly where large quantities of sulfur and other acid-forming materials have been used resulting in the leaching out of calcium, or in soils naturally very acid, the calcium may be a direct nutrient deficiency.

Magnesium—Magnesium generally runs from 2,500 to 4,000 parts per million in the foliage of a well-nourished fruit tree. In recent years it has become apparent as a result of research that magnesium may be a limiting element for tree nutrition. An area where magnesium deficiency is known to be rather general is the Atlantic Coastal Plain from New England southward to the Gulf States. Magnesium deficiency in orchards was recognized first in citrus fruits in Florida, but in recent years numerous cases of magnesium deficiency have been recognized in other areas and with other tree crops.

Phosphorus—Although it is one of the most important fertilizer elements for annual and pasture crops, phosphorus is not generally deficient for tree fruits. Phosphorus is generally present in the foliage in the range of 2,000 to 3,000 parts per million. Fruit trees in most soils obtain this quantity of phosphorus without special fertilizer treatment.

Sulfur—Sulfur is an essential nutrient element present in the foliage in about the same quantity as is phosphorus. So much sulfur is added to orchards in connection with spraying for control of diseases and pests and in connection with the addition of other fertilizers such as sulfate of ammonia or sulfate of potash that the orchard requirements are apparently amply sup-

plied. In fact, the large amount of sulfur used frequently causes excess acidity in the soil. We know of no orchard areas where additional quantities of sulfur are needed from the standpoint of tree nutrition.

The Minor Elements

The five minor elements known to be essential for the nutrition of orchard trees are present in the foliage not in thousands of parts per million but generally as less than 100 parts per million.

Iron—Iron, a major constituent of soils, in general runs from 100 to 300 parts per million in the foliage, the highest level of the so-called minor elements. Iron deficiency occurs primarily in calcareous or alkaline soils where a sufficient quantity of iron in usable form cannot be taken up by the tree. Chlorosis due to iron deficiency is widespread in many areas from the Plains States west to the Pacific.

Zinc—Zinc in the foliage of the well-nourished tree runs from 25 to 50 parts per million. Zinc deficiency is widespread throughout the Western States and zinc is deficient for certain orchard crops, notably pecans and citrus in the Southeastern States. It is possible that some benefit from zinc would be obtained in other areas. Many peach orchards have appeared to be stimulated by the use of zinc-lime sprays.

Boron—The boron level in the foliage of tree fruits is generally about the same as the zinc level or from 25 to 50 parts per million. Symptoms of boron deficiency, particularly corky areas in the fruit, are widely recognized in many apple-producing districts. Soils derived from limestone are very likely to be deficient.

Manganese—Manganese is recognized as deficient in some citrus and tung orchards in Florida and must be supplied for optimum growth and fruiting. The level in normal fruit leaves is generally in the range of 50 to 100 parts per million.

Copper—Copper has been applied in large amounts in many orchards in the form of Bordeaux spray. Like manganese, it is recognized as sometimes deficient in Florida. It is generally present in healthy leaves at approximately 10 parts per million.

Diagnosing Nutrient Deficiencies

Visible symptoms of excessive nutrient deficiencies of the various elements have been described frequently. The small yellowish-green leaves, the reddish-brown bark, and small amount of twig growth characteristic of nitrogen deficiency in apple and peach orchards are generally recognized. Acute potassium deficiency results in slender twig growth, puckering and rolling of the leaves, and marginal burn of the foliage. Magnesium deficiency shows first as a yellowing in the areas between the veins of the leaf followed in acute cases by dying of the tissues of these areas. Excessive boron deficiency results in dying-back of new growth. Acute copper deficiency causes somewhat similar dieback symptoms. Zinc deficiency also results in dieback and in the formation of rosettes of very small, usually yellowish leaves. The almost white leaves resulting from iron deficiency are well known to Western orchardists.

The orchardist, however, is interested in preventing the development of such acute deficiency conditions. It is important to him to know when the trees are slightly deficient in potassium, magesium, or other nutrient elements so that he can correct the condition before acute leaf symptoms and serious lack of production develop. The use of leaf analyses to determine the nutrient level in the tree is proving of much value in this connection.

While leaf analyses will indicate the nitrogen level in the trees, a low nitrogen condition can usually be determined by general orchard observations of such items as color of leaves, amount of terminal growth, and general vigor. At present, leaf analyses seem to be of greatest value for determining the levels

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 5. Magnesium deficiency, Golden Delicious apple, normal leaf at left—Plant Industry Station, Beltsville, Md.

of potassium, magnesium, and calcium. The method is also valuable for determining phosphorus level although phosphorus deficiency rarely occurs in bearing orchards. Leaf analyses are also helpful in detecting deficiencies of the minor elements although visual symptoms of these deficiencies usually indicate the need for corrective measures before production is seriously affected.

The levels of the nutrient elements in the leaves do not remain stationary during the growing season. Nitrogen and potassium tend to decrease as the leaves become older while calcium and magnesium tend to increase. Samples taken near midsummer when the leaves are full grown and still relatively young appear to be best for diagnostic purposes.

Results of leaf analyses need to be carefully interpreted. They are of greatest value in developing a long-time program for the orchard. It is now well recognized that the elements potassium, calcium, and magnesium need to be in approximate balance in the leaves and other plant parts. Thus if the level of calcium is very high, larger quantities of potassium are required in the

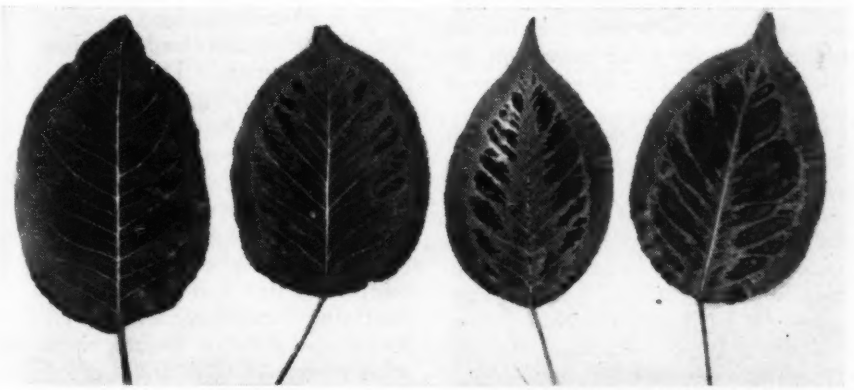

Photo by Bureau of Plant Industry, Soils, and Agricultural Engineering, U.S.D.A.

Fig. 6. Magnesium deficiency, Kieffer pear, normal leaf at left—Plant Industry Station, Beltsville, Md.

leaves than if the calcium supply is moderate. Conversely, heavy applications of potassium may accentuate a magnesium deficiency. Thus the level of all three of these elements should be known before the most satisfactory diagnosis can be made. If this situation is recognized, however, leaf analyses become a very valuable means of diagnosing potential deficiencies before the tree reaches an acute condition of nutrient element shortage.

Supplying Nutrients Through the Leaves

It has long been known that the leaves absorb soluble materials deposited on their surface. The leaf is a porous, sponge-like tissue and soluble materials, if applied to the surface, will penetrate the leaf. Nutrient elements so applied apparently enter readily into the nutrient compounds formed in the leaf.

Solutions of many chemicals applied to the leaves in appreciable concentration cause injury. Hence feeding a tree with nutrients applied to the leaves depends on finding materials that will not cause leaf injury. Boron in the form of boric acid or borax can be applied to the leaves without injury and the tree requirement can be supplied by spraying the leaves with these compounds. Copper and zinc can be applied through the leaves of certain plants such as citrus and pecans, but the zinc and copper compounds now available that are soluble generally cause injury on deciduous fruits. The same is true of soluble iron salts.

In recent years there has been great interest in supplying nitrogen through the leaves in the form of organic compounds such as urea. These compounds can be used in considerable concentration (up to about 5 pounds in 100 gallons of water) without causing leaf injury. It has been throughly demonstrated that practically all of the material that sticks on the apple leaf enters the tissue. Peach leaves, on the other hand, are much less effective in taking in organic nitrogen. Since nitrogen is required in very large amounts in the tree and is particularly needed in the early spring when rapid growth occurs, it is difficult to supply the full needs of the tree through the leaves. This could be done even with apples only by repeated spraying. Under some conditions, however, where it is desirable to get a quick nitrogen intake into the tree, foliage applications to apples are of value. If the tree has been well supplied with nitrogen as a result of soil applications there seems to be little special benefit from foliage spraying with nitrogen.

When the soils are alkaline or calcareous, applications of potassium, phosphorus, zinc, and iron to the soil frequently result in no increase in these materials in the tree. So far as tested, potassium and phosphorus are taken in through the leaves only to a limited extent. Research is needed on the possibility of developing organic compounds of these materials which could be applied to the foliage in high concentrations. Such compounds would have to be noninjurious to the leaves and at the same time soluble in water. If such compounds of potassium, phosphorus, iron, and zinc could be developed, their usefulness in tree nutrition under conditions where they are not available to the tree from soil applications would be very great.

Much progress has been made in the last decade in our understanding of orchard nutrition. The use of leaf analyses in studying nutrient levels in trees has contributed greatly to the progress. The possibility of supplying nutrient elements through the leaves is now more generally recognized but wider use of this method is dependent upon developing and testing suitable compounds that will not cause injury. Supplying these materials through the leaves would be of greatest value in areas where soil applications of certain of the nutrients are unsatisfactory because of the high fixing power of the soil.

Know Your Soil
X. Woodstown Sandy Loam

By J. B. Hester, R. L. Isaacs, Jr., and F. A. Shelton

Department of Agricultural Research, Campbell Soup Co., Riverton, New Jersey

THE Woodstown sandy loam is an important soil along the North Atlantic Seaboard. This soil consists of a light brown to brown sandy loam and in some places is a heavy sandy loam. The surface soil, where not severely eroded, is 7 to 10 inches deep. The Woodstown series is an imperfectly drained soil. Therefore, the subsurface below the 10-inch depth grades into a mottled yellow or yellow brown and bluish gray sandy clay. In many cases, below the 20-inch depth, the soil changes to a somewhat plastic clay. The soil is generally between 4 and 5 feet deep and rests on sand or gravel or a combination of sand and gravel. This soil is from slightly sloping to level in topography and is often characterized by the presence of water-worn pebbles.

The Woodstown series is generally recommended for pasture land, corn, and grain. A typical analysis of the Woodstown soil is as follows:

pH	*Lbs./A:*		*Toxic*	*%*	*Lbs. per acre*		
	Ca	*Mg*	*Aluminum*	*Organic Matter*	*P_2O_5*	*K_2O*	*Mn*
5.2	450	150	High	2.3	2	50	5

Hester extracting solution

It is obvious that this soil is low in available phosphorus. This condition is created by the imperfect drainage condition which brings into solution ferrous iron. The ferrous iron precipitates the phosphorus as insoluble ferrous phosphate. The available potassium is low and the soil responds to potash. Ten pounds of borax per acre are needed for most crops.

Since this series of soils has somewhat of a marginal tendency, it may be interesting to study some of the things that have been done through research to make this soil productive. Liming to an optimum pH value is essential. It requires from 1 to 2 tons of a finely ground limestone to establish a pH value favorable for most vegetable and agricultural crops. The liming of this soil does more than correct the pH value; it eliminates the solubility of

Fig. 1. Carrots in foreground cultivated and those in background weeded but uncultivated.

Fig. 2. Suffocation of plant roots by accumulated water due to an improperly sloped headland.

Fig. 3. Surface erosion in one year because of improper consideration of soil problems.

Fig. 4. Better than a 100-bushel corn crop through proper fertilization on the Woodstown sandy loam.

toxic elements like aluminum and even iron and manganese which are essential to plant growth but toxic in excessive concentrations. It tends to coagulate the clay and make the soil more friable and better aerated for plant roots. It tends to facilitate the movement of water through the soil and create a more favorable medium for desirable micro-organisms.

Aeration of the Soil

Among other things essential to this soil is aeration. Aeration can be enhanced by cultivation. Deep cultivation is essential. Figure 1 shows carrots on cultivated and uncultivated Woodstown sandy loam. Where the soil was uncultivated, but weeds otherwise controlled, carrots made practically no growth; whereas when the soil was properly cultivated, carrots made excellent growth. The increase in yield was seven times the uncultivated. Oxygen is essential for root growth and is essential for the favorable micro-organisms in the soil. Where there is insufficient oxygen in the soil, anaerobic bacteria flourish, bringing into solution toxic concentrations of ferrous iron and manganous manganese.

Drainage

Since this soil is imperfectly drained, drainage is extremely important. Where this soil is slightly sloping, underground drainage can be very effective. However, many other methods of eliminating excessive water are also effective. The rows of the particular crop concerned can be contoured in such a manner as to effectively eliminate excessive rainfall standing on the soil. Excessive water tends to accumulate in pockets, particularly at the headlands. Figure 2 shows the effect of water accumulated at a headland which has been improperly sloped. A limited amount of effort in removing the accumulated soil on the headlands would have prevented the accumulation of water which suffocated plants in that area. Properly sloping headlands is far less time-consuming than the actual planting and cultivating of the plants concerned in that area.

Erosion

Slightly sloping Woodstown soil will erode if proper contouring of the rows and inclusion of organic matter in the soil have not been provided. Figure 3 shows erosion of the soil caused by the lack of these conditions. Allowing these conditions to develop makes it more difficult to effectively utilize this marginal soil.

Organic Matter

The Woodstown soil is characterized, as mentioned before, as a grain, corn, and pasture soil. Advantage should be taken of this fact to grow these crops effectively. With the proper use of fertilized it has been possible to

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How to Buy a Sprinkler System

By John W. Wolfe

Oregon State College, Corvallis, Oregon

BEFORE a man buys a sprinkler system he should first make sure that sprinkling is the best method of irrigation for his farm. Sprinkling has many advantages, but it also has one big disadvantage and that is cost. There are some cases where gravity irrigation can do just as good a job and do it cheaper than sprinkling. Sprinkling does, however, seem to be gaining advantage on more and more farms in the Willamette Valley.

When the selection of method has been made, an inventory of the resources must follow before any money is invested. It may be necessary to test the yield of a well or to verify a water right. A rule of thumb that can be used to determine if the water supply is adequate is to multiply the number of acres intended to be irrigated by six gallons per minute. The resulting figure is approximately the quantity of water that will be required to irrigate the acreage if it flows 24 hours a day 7 days a week.

Another important point to check is the power supply. It is never wise to buy a system until a check has been made with the power company to make sure they will be able to supply the power needed. For example, single phase lines usually have a limit of 5 or 7½ h.p.

Assuming that all of the conditions mentioned have turned out favorably for sprinkler irrigation, a sprinkler dealer should be approached. It is suggested that particularly when buying a larger system entire dependence is not put on the design from one dealer, but that two or three dealers be asked to design and bid on the system. This, of course, invites a certain amount of difficulty because then a choice between two systems must be made and sometimes the designs different dealers make will vary quite a bit. The figures presented here might help make this selection.

First, check the system capacity to see whether or not it will supply about six gallons per minute per acre. Next, check the size of mainline to see whether or not the most economical size has been selected. The selection of mainline size should actually be carefully figured for each system. The figures presented here are only guides because there are so many variable factors which affect them. However, they are somewhere near specifications for a typical condition in the Willamette Valley. If the flow is 0 to 30 gallons per minute, a 2-inch pipe is suggested; for 30 to 90 gallons per minute, a 3-inch pipe; for 90 to 160 gallons per minute, a 4-inch pipe; for 160 to 300 gallons per minute, a 5-inch pipe; for 300 to 500 gallons per minute, a 6-inch pipe; for 500 to 700 gallons per minute, a 7-inch pipe; and for 700 to 900 gallons per minute, an 8-inch pipe.

Another thing to check is the rate of application of the water. For a very heavy soil, the sprinklers should not discharge more than 6 or 7 gallons per minute on a 40 by 60 spacing. For medium soils, the sprinkler should discharge not more than 7 to 10 gallons per minute. For very light-textured soils, the rates can go higher but the usual accepted rates are between 7 and 15 gallons per minute per sprinkler on a 40 by 60 spacing. If the sprinkler designated applies less than 6 or 7 gallons per minute, it must be placed

on spacing closer than 40 by 60 to get uniform distribution.

Another important item to check on the system is the size of the lateral. Some consideration should be given to the selection of the sprinkler lateral size by economy. This process gets involved, however, because the labor cost of moving the pipe also enters in. Usually what determines the size of a sprinkler lateral is the required uniformity of distribution from one end to the other. Agricultural engineers have suggested a figure for maximum pressure loss in a sprinkler lateral. They consider that the maximum pressure loss should be no more than 20 per cent of the initial pressure. To stay within this 20 per cent, the following figures represent the maximum number of sprinklers of a given size that can be put on a given size pipe.

Pipe size	Sprinkler size	Max. No. sprinklers
2″ pipe.....	6 g.p.m.	9
2″.....	8	7
2″.....	10	6
3″.....	6	20
3″.....	8	16
3″.....	10	14
4″.....	6	33
4″.....	8	28
4″.....	10	24

These maximum figures apply to level land. If a sprinkler lateral goes uphill from the mainline, the maximum number of sprinklers on the line must be materially reduced. Figures are based on uniform pipe size in a lateral. If pipe size is reduced, these figures do not apply.

Speaking of pressures, there is a recommended pressure at which each of the common sprinklers on the market operates best. The distribution pattern from the sprinklers is not good if the pressure gets too low and it is not good if the pressure is too high. These data can be obtained from the manufacturers for individual sprinklers. The following figures, however, might be used as a general guide for a suggested pressure at the last sprinkler on the line: For 6 or 7 gallons per minute, 30 pounds; for 8 to 10 gallons per minute, 35 pounds; for 12 to 15 gallons per minute, 40 pounds.

There are some practical points also that should not be overlooked. The system should be able to reach all parts of the field with a minimum amount of labor in moving the pipe. It must be suited to the special crop being grown, and the labor schedule must fit into farm operations.

It might be a good idea to ask the equipment supplier to attach a couple of fittings to the pump for the application of fertilizer. Soluble fertilizer can be successfully applied to the soil through the sprinkler system. Fertilizer can be drawn from a barrel through a hose to the suction side of the pump. As it goes through the pump, it is thoroughly mixed with the water and is discharged out through the sprinklers. The barrel can be refilled by a hose from the discharge side of the pump.

Last, but not least, of the points to select is the pumping system. The dealer should be able to guarantee at least a 60 per cent pump efficiency and 75 per cent pump efficiencies are not uncommon. It is possible that the dealer who designs the best irrigation system may not have the most efficient pump to sell for the particular set of operating conditions under consideration. It may be desirable, therefore, to compare selections of more than one make of pump provided the sprinkler designer will supply the head and discharge specification needed for selecting a pump.

If an irrigation system is purchased, it should be used. It should not lie idle while crops are drying up. It is also important to follow the irrigation schedule which has been worked out with the dealer. If this is not done, too much pressure may be lost before the water reaches the sprinklers.

Topdressing Legume Meadows in Iowa

By George Stanford and John Hanway

Iowa State College, Ames, Iowa

TOPDRESSING phosphate and potash fertilizers on legume meadows often pays dividends where soils are deficient in these nutrients. Of course, this doesn't mean that topdressing should be substituted for the firmly established practice of fertilizing the new seeding. Topdressings should supplement rather than substitute for fertilization at seeding time. The initial fertilizer application gives the new seeding the boost it needs for good stand establishment and early vigorous growth. Later applications may be needed on the low-fertility soils where not enough phosphate, potash, or both of these elements were supplied initially.

Topdressing Phosphate

Topdressing superphosphate on leguminous meadows has increased yields under a rather wide range of soil and seasonal moisture conditions in Iowa. It has been known for several years that poor growth of alfalfa or red clover on the neutral to high-lime soils of northcentral and western Iowa often is due to phosphate deficiency. Topdressing 300 to 400 pounds of 0-20-0 per acre in such cases has given spectacular results, often doubling or even tripling the yields of hay.

On the soils where heavy applications of phosphate are needed, farmers often fail to apply enough of this nutrient at seeding time to maintain good hay production over a two- or three-year period. An example of such a low-phosphorus soil is the calcareous Ida silt loam in western Iowa. During 1950 on one of these Ida soils, yields of second-year alfalfa-bromegrass meadow were 0.5, 1.8, 2.8, and 4.0 tons per acre on plots which had received none, 300, 600, and 1,200 pounds of 0-20-0 per acre respectively when the mixture was seeded. In this same experiment, topdressing 300 pounds of 0-20-0 on second-year meadow plots, which also had received this amount of phosphate at seeding, resulted in an additional 1.3-ton per acre yield increase. The corresponding yield increase in 1949 from topdressing phosphate in this experiment was only 0.4 ton per acre, but moisture conditions were much less favorable than during 1950.

Topdressing phosphate fertilizer also has been very profitable in Iowa on acid soils testing low to very low in available phosphorus. Most of the field trials have been conducted in eastern and southern Iowa on various prairie and forest-derived soils during the past few years. In 1949 we studied the effect of topdressing phosphate on first-year stands of alfalfa. Superphosphate (0-20-0) was applied in early April at the rate of 300 pounds per acre, alone and in combination with potash. At 12 of 16 locations, alfalfa yield increases due to phosphate ranged from 300 to 1,200 pounds of cured hay per acre. Dry weather following the first cutting probably prevented top yield responses. Ten of these fields had received the equivalent of 150 to 200 pounds of 0-20-0 and four others had gotten either manure or rock phosphate at time of seeding.

Again in 1950, phosphate topdressings gave good results on both alfalfa and red clover. Average responses for 1950 are shown in Table III. Moisture conditions were generally favorable, especially for the first cutting. On eight very low-phosphorus fields in northeastern and southeastern Iowa, yield increases of alfalfa from an early April topdressing of 300 pounds of 0-20-0 averaged 1,200 pounds per acre. Average increase from a 600-pound rate was 1,600 pounds per acre. Table I shows the relation of soil test values to yield responses in these 19 experiments.

TABLE I. YIELD RESPONSES TO PHOSPHORUS IN RELATION TO SOIL-TEST VALUES FOR AVAILABLE PHOSPHORUS

No. of expts.	Phosphorus level in soil* (lbs./A.)	Average yield increases (lbs./A) from applying	
		330# 0–20–0/A	600# 0–20–0/A
8.....	3 or less	1,200	1,600
6.....	3.1–5	600	800
5.....	5 or more	300	500

* Bray No. 1 extractant, used by Iowa State College Soil Testing Laboratory. Soil samples from 0"-6" layer.

From these results it is evident that alfalfa and red clover utilize topdressed superphosphate quite effectively. Alsike and ladino clover also respond well to topdressing according to our limited results and the data obtained in other states. Apparently the roots near the soil surface are rather efficient feeders. Samples of legume taken from each of the experiments in 1950 were analyzed for total phosphorus content. Without exception, phosphate topdressing increased the percentage of phosphorus in the plants even where marked growth responses occurred. This is illustrated in Table II for two soils which differed considerably in phosphorus status.

Notice that the phosphorus content of the alfalfa was only 0.14 per cent on the Glew field where no phosphorus was applied. This percentage is regarded by some authorities as being too low to supply the phosphorus needs of growing livestock and dairy cows without supplemental phosphorus. Such a low content of phosphorus, or even lower, has been found in alfalfa from certain high-lime soils of northcentral Iowa. Fertilizer increased the phosphorus content of the hay on the Glew field to a point well above the critical level, even though the yield of hay was increased approximately threefold.

Need for Potash

In Iowa, the need for potash on legume meadows is not so widespread as the need for phosphorus. However, legume meadows are likely to be lacking in potash rather often in certain soil areas, particularly on the Carrington-Clyde soil area in the northeastern part of the State. The most severe cases of potash deficiency occur in this area. A relatively high proportion (approxi-

TABLE II. EFFECT OF PHOSPHATE TOPDRESSING ON YIELD, PER CENT PHOSPHORUS IN THE PLANTS, AND TOTAL PHOSPHORUS REMOVED BY THE CROP

Lbs. 0–20–0 applied	Glew field, pH *6.25* (Dodgeville silt loam)			Mielke field, pH *6.7* (Fayette silt loam)		
	None	300	600	None	300	600
Yield, 2 cuttings (T/A).....	0.93	2.40	2.90	2.36	2.74	3.08
% P, 1st cutting.....	0.14	0.21	0.26	0.24	0.31	0.34
Lbs. P removed/A, 2 cuttings....	2.8	9.7	14.0	12.2	16.7	20.8

These pictures of an alfalfa-clover-timothy meadow in Delaware County, Iowa, show results of top-dressing. On this field, 300 pounds of 0-20-20 gave a total yield increase of about 1.7 tons per acre for two cuttings.

mately 20%) of the soils sent in by farmers of this area test very low—less than 100 pounds of available potassium (K) per acre. In other areas, the proportion of very low-potash soils is considerably less than this. Soils testing low (100-130 pounds of potassium per acre) occur rather frequently in the northcentral, eastern, and southern sections of the State. Soils in the western part of the State are generally well supplied with available potassium.

Potash top dressing can be expected to increase the yield of alfalfa on practically all soils testing low in available potassium. This was true in 1950 on 16 low-potash fields in northeastern and southeastern Iowa, none of which had

TABLE III. EFFECT OF TOPDRESSING PHOSPHATE AND POTASH FERTILIZERS ON ESTABLISHED LEGUME MEADOWS UPON HAY YIELDS, 1950 [1]

No.	Soil	pH	No. of cuttings	Yield without fertilizer (Lbs/A)	Average yield responses from topdressing (Lbs/A)			
					Phosphate		Potash	
					300# /A 0–20–0	600# /A 0–20–0	100# /A 0–0–60	200# /A 0–0–60
1	Fayette silt loam	6.7	1	1,450	0	200	250*	300*
2	Fayette silt loam	6.6	2	5,300	200	600*	350	600*
3	Fayette silt loam	6.7	2	4,750	700**	900**	250	400*
4	Fayette silt loam	6.7	2	4,700	850**	900**	600*	800**
5	Dodgeville sandy loam	6.3	2	1,850	2,650**	3,600**	700**	700**
6	Floyd silt loam	6.0	1	2,700	800**	1,300**	300*	750**
7	Floyd silt loam	6.2	2	6,250	950**	1,500**	200	1,200**
8	Floyd silt loam	6.3	1	4,380	0	0	300	450
9	Carrington sandy loam	6.5	2	5,100	1,800**	2,650**	1,450**	2,250**
10	Carrington silt loam	6.2	1	3,880	350**	500	450	450
11	Lindley loam	6.4	3	5,900	1,000**	1,350**	800*	900**
12	Weller silt loam	6.3	3	6,000	600**	800**	200*	650**
13	Weller silt loam	6.2	3	4,200	850*	1,200**	800*	1,000**
14	Weller silt loam	6.5	3	4,100	1,450**	1,800**	500*	850**
15	Weller-Marion	6.1	3	6,950	500**	800**	350	400*
16	Marion silt loam	6.8	2	4,750	350	500	350	50
17	Grundy silt loam	6.4	3	7,050	300	600*	500*	750**
18	Givin silt loam	6.3	3	7,700	650**	600**	400*	850**
19	Seymour silt loam	6.6	2	5,350	350	200	200	400*

[1] All were alfalfa or mixtures predominantly alfalfa, except Nos. 6 and 8 which were predominantly red clover.

* Significant at 5% level.
** Significant at 1% level.

received any potash at seeding. Plots were topdressed with 100 and 200 pounds per acre of muriate of potash (0-0-60). On fields responding to potash, yield increases ranged from 200 to 1,450 pounds per acre for the 100-pound rate, and from 300 to 2,250 pounds per acre for the 200-pound rate, as shown in Table III.

It is obvious, of course, that significant increases from these rates of application were not always profitable increases. However, such an increase even though relatively small, reveals a need for additional potash, but at a lower rate than was used in the experiments. Using an 0-2-1 rather than an 0-1-1 ratio might be desirable in such cases where the need for potash is considerably less than the need for phosphate.

Although all the experiments were located purposely on fields where the surface soil tested low to very low in available potassium, yield increases on some of the soils were relatively small while others were large. Results obtained on two soils differing widely in potassium supplying power are presented in Table IV for the purpose of illustration.

That the potash deficiency of alfalfa on the Carrington soil was greater than on the Weller soil is shown by plant analyses. First cutting hay from the plots that received phosphate but no potash contained only 0.57% potassium as compared to 1.78% on the Weller soil. According to studies in New York, Wisconsin, and elsewhere, 0.57% would be regarded as a critically deficient level of potassium in alfalfa.

New Jersey workers have set 1.4% potassium as the critical level for alfalfa, below which definite yield increases should be obtained from potash application, and 2.0% potassium as an ideal value for alfalfa.

TABLE IV. EFFECT OF POTASH TOPDRESSING ON YIELD AND POTASSIUM CONTENT OF ALFALFA ON TWO IOWA SOILS

Soil	Humes field Carrington loam, pH 6.5			Martin field Weller silt loam, pH 6.25		
Soil treatment (lbs/A)	600 0–20–0	600 0–20–10	600 0–20–20	600 0–20–0	600 0–20–10	600 0–20–20
Yield (T/A)*	3.78	4.54	4.89	3.29	3.63	3.70
% K in 1st cutting	0.57	0.95	1.49	1.78	2.21	2.47
K removed* (lbs/A)	51	97	144	115	149	167

* No. of cuttings taken: Carrington—2; Weller—3.

It is worthy of mention that although an application of phosphate alone on the Carrington soil increased the yield by 1.23 tons per acre, no more potassium was removed in the hay from the plots that received phosphate than from the plots that received no phosphate. Thus, phosphate application resulted in an increase in yield and a proportional decrease in percentage in the hay. This would indicate that most of the increase in potassium in the hay from potash-treated plots was derived from the fertilizer potash. The data in Table IV indicate that the hay removed in two cuttings from the plots topdressed with 120 pounds of K_2O (100 pounds of K) per acre contained 93 pounds per acre more K than the hay from the plots that received no potash. Apparently most of the potash applied was removed by the hay crops in this one season. On the Weller soil approximately one-half the fertilizer potash was removed by the hay in three cuttings. In the latter case, it is evident that the plants took up more potash than was needed for normal growth. In other words, luxury feeding occurred.

The extreme difference in uptake of potassium by the alfalfa from these two soils cannot be explained on the basis of the relative content of available potash in the soil samples from the plow layer. Two important factors are involved. In the first place, the Carrington soil releases potassium from relatively unavailable to available form much more slowly than the Weller soil, according to recent unpublished data from this station. Secondly, the distribution of available potassium with depth differs considerably as shown below (expressed as pounds of available potassium per acre 6 inches):

Depth	Carrington loam	Weller silt loam
0–6″	72	96
6–12″	70	104
12–24″	92	260

It is obvious that such differences between soils must be taken into account in establishing useful correlations between available potassium content and crop response to potash fertilization.

The method of potash fertilization should be quite different for these two soils. For the Weller soil a moderate application of potash at seeding time to insure establishment of a good stand and supply some potassium in the surface soil would probably be all that is needed, since after the first year the alfalfa will draw on the available potassium in the subsoil. However, on the Carrington soil not only is potash at seeding time needed to establish the stand but subsequent topdressings

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Plentiful Seed for Soil Conserving

By J. S. Buie

Soil Conservation Service, Spartanburg, South Carolina

TEN million acres planted to grass and legumes in 1951!

That is the potential acreage which can be planted from the 354 million pounds of seed, kudzu crowns, and grass stolons harvested by farmers in soil conservation districts in the nine Southeastern States and Puerto Rico last year.

The estimate made by Soil Conservation Service workers assigned to cooperate with the more than 400 soil conservation districts in the Region shows that a total of 306 million pounds of grass and legume seed and 48 million pounds of kudzu crowns and grass stolons were harvested.

Most of these are perennials or reseeding annuals. Once a stand is secured, it is not necessary to plant the same field again, so long as satisfactory growing conditions are maintained. Thus the 1951 planting, as well as every other year's, represents a tremendous total increase to the acreage already established. While none of the seed can be used for human food or even for animal consumption, the growing plants of most species provide excellent grazing, hay, or silage—thus contributing to the increasing livestock production in the Southeast.

All of these things make for a better type of agriculture. Throughout agricultural history, the South has suffered from a system of farming based on annual row crops. It has been necessary to prepare the land anew every year, and it is well known that every time sloping fields are plowed more soil is lost.

The close-growing grasses and legumes of which we are talking fit into the current program for soil and water conservation which is so popular in all the states of the South today. There are at present in the nine Southeastern States, Puerto Rico, and the Virgin Islands 345,537 farmer-cooperators with the more than 400 soil conservation districts; and their combined farms represent a total of 57 million acres, which is approximately 35 per cent of the total land in farms in the Region.

Each one of these cooperators is doing his part in the development of a sound soil and water conservation program. Most of them already have realized the importance of an adequate supply of planting material if the necessary acreage of these crops is to be planted and if the land is to be conserved while being used to produce ever larger crops.

Many of the crops grown from these seed serve not only as feed for livestock, but the residue after grazing—or in some cases the entire plant, as with blue lupine—is returned to the land for soil improvement.

Need for Fertilizers

Farmers are finding it to their advantage to fertilize such crops and it is not unusual to see farmers using more fertilizer per acre for their pasture or for hay than they formerly used for cotton or other cash crops. It is a well-recognized fact among farmers as well as agricultural scientists that legumes require large quantities of

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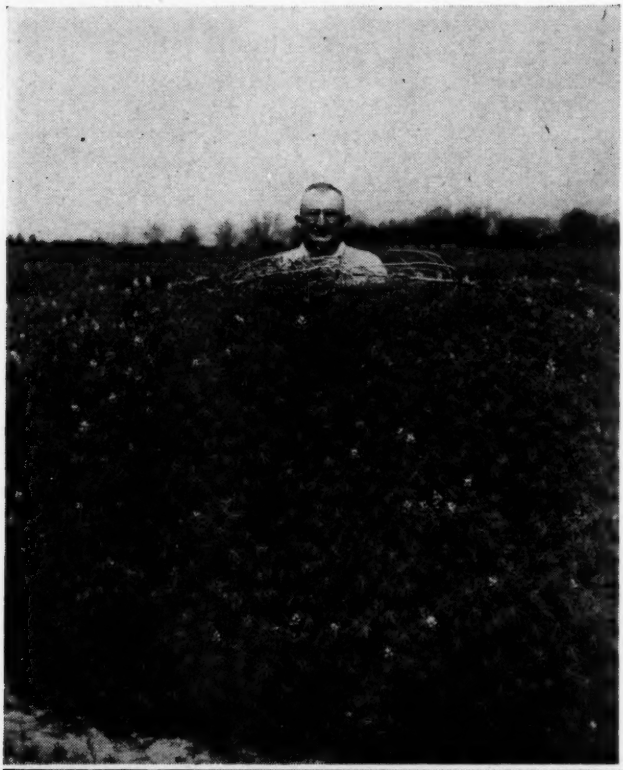
Reseeding strains of crimson clover that have been developed during recent years have greatly increased the importance of crimson clover as a winter cover and grazing crop. This has volunteered for 10 years on the farm of J. B. Mask in Spalding County, Ga.



Left: Blue lupine is another important new winter cover crop in the lower South, particularly for peanut lands. The 19-acre field seen here on the farm of V. E. Avery, Jr., near Powersville, Ga., was seeded in October, following watermelons.

Below: Annual lespedeza is not a new crop in the Southeast, but its acreage is expanding in the new grassland farming program that is spreading across the region. This is first-year Kobe lespedeza on the farm of D. J. White, near Eastman, Ga.

Above: Caley (wild winter) peas are becoming increasingly popular for overseeding on kudzu and other perennial summer legumes to extend the grazing period. In this field on the farm of J. L. Cooley, near Mize, Miss., they are being used for winter cover and seed production.

Right: Crotalaria has become a popular summer legume in the Coastal area and sandhills of the lower South, where it is adding heavy tonnages of green manure to sandy soils. The variety seen here on the farm of Sam G. Long, near Sandersville, Ga., is giant striata and is more than six feet tall.

Above: **Outstanding among the new grazing crops in the Southeast is Kentucky-31 fescue. This scene shows a two-year-old planting being harvested for seed on the farm of Peden Gaston, near Woodruff, S. C.**

Below: **Ladino clover is being widely used in grass-legume mixtures. Kentucky-31 fescue is one of the popular companion crops in grazing mixtures. Ladino is seen here with orchard grass on a land-utilization project.**

The Editors Talk

Mobilizing Agronomists for Defense

Recognizing that in a national emergency a man's value to his country may depend more upon his being assigned to duties he is well qualified to perform than on his nearness to the front, there is now under way a move to secure a registration of all established agronomists (crops and soils). The information obtained will be made available to the National Security Resources Board.

Why is an agronomist militarily important? First to come to mind is his influence on increased food production. The development of high-yielding strains of crops, the use of soil tests to govern land management and the efficient use of fertilizer supplies, the release of manpower for industry and the armed forces through teaching methods resulting in greater unit production, all bespeak his value.

More specifically, a Committee appointed by the American Society of Agronomy made up of Wm. A. Albrect, Chairman, Department of Soils, University of Missouri, W. H. Leonard, Professor of Agronomy, Colorado State College, J. B. Peterson, Head, Department of Agronomy, Purdue University, S. C. Vandecaveye, Professor of Soils, State College of Washington, and chairmanned by C. L. W. Swanson, Chief Soil Scientist of the Connecticut Agricultural Experiment Station, has some twenty suggestions for use of these trained men in the Armed Forces, including:

1. To supervise the establishment and maintenance of grass and other suitable vegetation at military airports to safeguard airplane engines from dust, reduce local air instability, and reduce visibility hazards from dust.
2. To supervise the establishment and maintenance of vegetative cover on local watersheds to prevent silting-in of harbors and navigable waterways, or the damaging of military and civilian operations by flash floods or soil erosion.
3. To investigate soils and their treatment for temporary runways, roads, and landing beaches.
4. To map soil types, to collect soil information, and to interpret such information in terms of military usage for possible trouble areas.
5. To interpret the soil types, cover, and terrain from aerial photographs.
6. To investigate methods of destroying enemy crops and of safeguarding our own.
7. To supervise the production of food for the rehabilitation of conquered areas, on military bases isolated from supply centers, for the United States and allied countries by maintaining production and saving of crops for local usage during invasion to prevent starvation in combat areas.
8. To supervise the development and production of chemurgic plants and textile crops such as guayule for rubber, castor beans for airplane engine oil, hemp for ship lines, etc., and cotton for clothing, etc.

9. To help in wartime chemical industry and research, chemical warfare research, wartime physics, military ordnance, soil mechanics, and permafrost research.

10. To advise on efficient utilization and distribution of basic fertilizer materials, since the chemicals used in the production of fertilizers are also used by the munitions industry.

11. To aid in biological warfare, medical research, and sanitary engineering, and in civilian defense in the instruction of line officers and others in the techniques of protecting personnel in the hazards of atomic warfare.

12. To plan and supervise the camouflaging of military installations by rapid establishment of vegetation.

13. To plan and supervise the handling and storing of perishable foods.

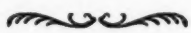
14. To study enemy food potential, topography, soils, vegetation, climate, etc.

15. To act as food and agriculture experts in the military government.

16. To aid in the procurement of food for the military.

17. To appraise lands acquired by the military and also damages to land or crops.

It is to be hoped that these specialized skills of our soils and crops men will be given due consideration by the National Security Resources Board. In World War II far too many of these younger scientists were drafted for combat duty and their long years of training and their talents were wasted. The agronomists are not asking for special privileges. They are merely suggesting that they be assigned to services where they can render full value to their country.



Don't Work in Dark

Dr. F. J. Salter, in charge of the Soils Inventory Laboratory at Ohio State University, stated in a recent publicity release that applying lime and fertilizer without testing the soil is like painting a house in the dark. You may not apply the right material, you may not use the right amount, and you may get it in the wrong place.

"Some people use 3-12-12 when they need 3-9-18," he says. Where potash is needed, he recommends 3-9-18; to correct a phosphorus deficiency, 4-16-8 instead of 3-12-12. There have been cases where farmers applied lime that was not needed. Soil tests will correct such mistakes. Most efficient lime and fertilizer programs include soil testing before applications are made.

This is a good time for farmers to have their soils tested. Laboratories are not as crowded as they will be later and samples that come in now will get faster processing. Fields going into wheat this fall and legumes and grass next spring can be tested now. Lime, phosphate, and potash needs must be supplied for good wheat yields and are even more important to legumes. Dr. Salter says that lime applied early will become available and will be more effective than if it is applied closer to legume seeding time. Tests now will help farmers know where and how much lime is needed so that it can be spread right away.

This good advice on the fall testing of soils is being emphasized throughout the country. It is to be hoped that it will be heeded—not only for a more efficient and economical use of fertilizer materials but for a saving of time in next year's farming operations.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1925.....	19.6	16.8	170.5	165.1	69.9	143.7	12.77	31.59	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930...	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931...	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932...	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	46.3	128.0	214.0	119.0	186.0	16.55	43.40	....
1950									
August.....	36.95	53.1	122.0	218.0	144.0	197.0	15.45	70.90	....
September...	39.98	55.4	105.0	192.0	144.0	194.0	15.55	78.80	....
October.....	38.90	55.1	85.8	154.0	137.0	191.0	15.85	81.50	....
November....	41.13	52.5	87.8	148.0	137.0	194.0	16.45	98.40	....
December....	40.36	47.2	88.9	173.0	145.0	203.0	17.05	102.00	....
1951									
January.....	41.31	45.9	98.6	194.0	154.0	209.0	17.85	101.00	....
February....	41.75	32.5	103.0	205.0	160.0	221.0	18.45	100.00	....
March.....	42.73	26.6	107.0	207.0	160.0	212.0	18.35	103.00	....
April.....	43.17	25.3	112.0	203.0	162.0	214.0	18.35	103.00	....
May.....	42.45	39.8	109.0	209.0	164.0	211.0	18.15	101.00	....
June.....	42.02	49.0	108.0	210.0	162.0	208.0	16.85	95.60	....
July.....	39.11	49.5	118.0	219.0	163.0	205.0	15.45	78.00	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1925.....	158	168	245	188	109	163	108	140	143
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	463	184	244	210	210	139	192	201
1950									
August.....	298	531	175	248	224	223	130	314	164
September...	322	554	151	219	224	219	131	349	126
October.....	314	551	123	175	213	216	134	361	138
November....	332	525	126	169	213	219	139	436	188
December....	325	472	128	197	226	230	144	452	211
1951									
January.....	333	459	141	221	240	236	150	448	324
February....	337	325	148	233	249	250	155	443	333
March.....	345	266	154	236	249	240	155	457	265
April.....	348	253	161	231	252	242	155	457	225
May.....	342	398	156	238	255	239	153	448	230
June.....	339	490	155	239	252	235	142	424	189
July.....	315	495	169	249	254	232	130	346	204

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per Unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per Unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1925	3.11	2.47	5.41	5.34	3.97	4.75
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.60	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950						
August	3.00	1.71	11.44	11.06	10.62	9.87
September	3.00	1.71	11.44	10.85	10.85	10.32
October	3.00	1.71	11.86	10.63	10.62	10.32
November	3.00	1.68	11.96	10.63	10.85	10.62
December	3.00	1.88	13.48	10.95	10.93	10.93
1951						
January	3.10	1.88	13.37	11.30	11.29	11.11
February	3.13	1.88	13.58	11.39	11.53	11.30
March	3.13	1.88	13.56	11.41	11.53	11.53
April	3.13	1.88	13.61	11.50	11.17	11.35
May	3.13	1.88	13.84	10.41	10.09	10.25
June	3.13	1.88	13.53	9.98	8.87	8.50
July	3.13	2.03	12.37	10.06	8.68	8.56
Index Numbers (1910-14 = 100)						
1925	115	87	155	151	117	135
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950						
August	112	60	327	313	315	280
September	112	60	327	307	322	293
October	112	60	339	301	315	293
November	112	59	342	301	322	302
December	112	66	385	310	324	311
1951						
January	116	66	382	320	335	316
February	117	66	388	323	342	321
March	117	66	388	323	342	328
April	117	66	389	326	331	322
May	117	66	395	295	299	291
June	117	66	387	283	263	241
July	117	71	353	285	258	243

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1925	.600	2.44	6.16	.584	.860	23.72	.483
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950							
August	.760	3.76	5.47	.368	.704	13.98	.193
September	.760	3.81	5.47	.368	.704	13.98	.193
October	.760	3.98	5.47	.386	.704	13.98	.193
November	.760	3.98	5.47	.386	.732	14.72	.193
December	.798	3.98	5.47	.420	.796	16.00	.210
1951							
January	.810	3.98	5.47	.420	.796	16.00	.210
February	.810	3.98	5.47	.420	.796	16.00	.210
March	.810	3.98	5.47	.420	.796	16.00	.210
April	.810	3.98	5.47	.420	.796	16.00	.210
May	.810	3.98	5.47	.420	.796	16.00	.210
June	.810	3.98	5.47	.355	.708	13.44	.176
July	.810	3.98	5.47	.389	.768	14.72	.193
Index Numbers (1910-14 = 100)							
1925	110	68	126	82	90	98	74
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950							
August	142	104	112	67	74	58	82
September	142	106	112	67	74	58	82
October	142	110	112	70	74	58	82
November	142	110	112	70	77	61	82
December	149	110	112	75	84	66	85
1951							
January	151	110	112	75	84	66	85
February	151	110	112	75	84	66	85
March	151	110	112	75	84	66	85
April	151	110	112	75	84	66	85
May	151	110	112	75	84	66	85
June	151	110	112	65	74	56	80
July	151	110	112	70	81	61	82

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1925.....	156	153	151	112	100	131	109	80
1926.....	146	150	146	119	94	135	112	86
1927.....	141	148	139	116	89	150	100	94
1928.....	149	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	123	130	127	86	56	130	102	77
1942.....	158	149	144	93	57	161	112	77
1943.....	192	165	151	94	57	160	117	77
1944.....	196	174	152	96	57	174	120	76
1945.....	206	180	154	97	57	175	121	76
1946.....	234	197	177	107	62	240	125	75
1947.....	275	231	222	130	74	362	139	72
1948.....	285	250	241	134	89	314	143	70
1949.....	249	240	226	137	99	319	144	70
1950								
August....	267	248	243	131	85	321	142	70
September.	272	252	247	131	85	324	142	70
October...	268	253	247	131	85	323	142	73
November.	276	255	251	132	85	328	142	74
December..	286	257	256	138	88	346	149	78
1951								
January...	300	262	261	140	90	351	151	78
February..	313	267	268	141	91	358	151	78
March....	311	272	269	142	91	357	151	78
April.....	309	273	268	141	91	353	151	78
May.....	305	272	266	139	91	334	151	78
June.....	301	272	265	134	91	311	151	69
July.....	294	271	261	135	93	297	151	74

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only: manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Commercial Fertilizers 1950 Official Inspections 217," Agr. Exp. Sta., Univ. of Me., Orono, Me.

"Know Your Fertilizers," Ext. Serv., Miss. State College, State College, Miss., Pub. 193, (Rev.-18M) Apr. 1951.

"Fertilizer Inspection and Analysis; Fall, 1950," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Bul. 557, July 1951.

"Ohio Fertilizer Sales—1950," Dept. of Agron., Ohio State Univ., Columbus, Ohio.

"Inspection Report (Summary) of Official Samples on Seed, Feed and Fertilizer 1947-48 and 1948-49 Fiscal Years," Dept. of Agr., Oklahoma City, Okla., P. A. Yeats.

"County Fertilizer Data, July 1 through December 31, 1950," Agr. Exp. Sta., Tex. A & M College, College Station, Tex.

"The Effect of Fertilizers on the Yield of Corn and Sorghum at Nacogdoches," P. R. 1315, Jan. 29, 1951, H. C. Hutson and J. C. Smith; "Anhydrous Ammonia Fertilizer Tests on Various Crops at Bluebonnet Farm, 1950," P. R. 1316, Jan. 29, 1951, B. D. Hargrove and H. O. Hill; "Distribution of Fertilizer Sales in Texas, July 1-December 31, 1950," P. R. 1325, Feb. 14, 1951, J. F. Fudge; "The Effect of Different Amounts and Combinations of Nitrogen, Phosphoric Acid and Potash on the Yield and Quality of Sweet Potatoes at Nacogdoches," P. R. 326, Feb. 14, 1951, H. C. Hutson and J. C. Smith; "The Effect of Nitrogen, Phosphorus and Potassium on the Yield of Forage and Grain from Camellia Oats," P. R. 1327, Feb. 19, 1951, E. D. Cook, J. C. Smith, L. E. Crane, and R. P. Bates; "Effect of Sulphur, Nitrogen and Phosphorus Amendments on Cotton Production at the Blackland Station, 1950," P. R. 1336, Mar. 6, 1951, E. N. Stiver, R. J. Hervey, H. E. Hampton, and J. R. Johnston; "Corn Fertilizer Studies Near College Station 1949-50," P. R. 1339, Mar. 8, 1951, J. C. Smith, J. S. Rogers, J. F. Fudge, and J. E. Roberts; "Supplying Phosphorus to Range Cattle Through the Fertilization of Range Land," P. R. 1341, Mar. 12, 1951, E. B. Reynolds, J. F. Fudge, and J. M. Jones; Agr. Exp. Sta., Tex. A & M College, College Station, Tex.

"Commercial Fertilizers Consumption in the United States 1949-50," Bur. of Plant Industry, USDA, Beltsville, Md., W. Scholl and H. M. Wallace.

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Plentiful Seed . . .

(*From page* 22)

mineral elements, especially phosphate and potash, if best yields are to be secured.

In the early days of the soil conservation program initiated by the Federal government in 1933, the fear was frequently expressed that farmers who might be willing to withdraw land from cultivation under the conditions prevailing then—and plant it to a close-growing crop such as annual lespedeza, sericea, or kudzu—would plow up such crops and go back to row crops, should the opportunity arise for them to do so. The present-day reluctance of farmers to plow up their better pastures for other crops shows that they now recognize the value of grassland agriculture.

The seed of many of these new crops has been increased by the Soil Conservation Service in its seven regional nurseries and distributed to farmers through local soil conservation districts. For instance, in 1941, the Service bought 70 pounds of seed of a grass which had been growing for many years on the W. M. Suiter farm in eastern Kentucky. This grass has been found on the Suiter farm by an agronomist from the Kentucky Experiment Station and was planted in trial plots at the Station. It has been given the name "Kentucky-31 fescue," although it is still known as Suiter's Grass by many people.

The 70 pounds of seed purchased

from the eastern Kentucky mountain farm were planted in the Soil Conservation Service nursery at Chapel Hill, North Carolina, and in a few years the supply of seed was sufficient to distribute to farmers. One or more 5-acre seed-increase plots were established by soil conservation district supervisors in each of the 687 counties then in soil conservation districts in the Southeastern Region. It was conservatively estimated in 1950 that 17 million pounds of seed of this highly valuable grass were produced by farmers living within soil conservation districts in the nine Southeastern States. Most of these seed came from the 70 pounds purchased nine years previously by the Service.

Similar progress has been made with other crops. There are at least 25 or 30 new crops being extensively grown today which, 25 years ago, were entirely unknown or were not known in areas where they are common at present. Farmers talk freely about sericea lespedeza, kudzu, bicolor, Caley peas, button clover, and a host of other crops about which they had no knowledge at all a few years ago.

At last the South is developing a permanent type of agriculture, one that can be built upon and improved as the years go by. This is a situation which was not possible so long as a fresh start had to be made every year with annual crops most of which were planted in rows.

Topdressing Legume Meadows

(*From page* 21)

would be essential to maintain good yields.

In summary, present indications are that on many Iowa soils which have only slight to moderate potassium deficiencies, as indicated by available potash level in the surface 6 inches, the initial application at time of seeding may be all that is needed. In cases of more severe deficiencies, such as on the Carrington soil (see chart), the application of a moderate amount at time of seeding (40-60 pounds K_2O per acre) followed by the topdressing of 60 to 120 pounds K_2O on the second-year alfalfa is more desirable than application of a large amount at time of seeding. On extremely deficient soils, especially sandy soils, annual topdressings may be needed.

It should again be emphasized that topdressing applications should not be substituted for the application at seeding time. The application at seeding time is especially important in the establishment of stands on low-potash soils. Topdressing should only be used to supplement this practice where needed. Of course, potassium deficiencies should be corrected on fields with good stands, whether or not potash was applied at seeding time.

Need for Phosphate-potash Combination

Soils which are deficient in available potash often need additional phosphate as well. In 1950, for example, 19 sites were selected for topdressing experiments where soils were low to very low in available potassium, according to soil tests. Although no attempt was made to include phosphorus-deficient soils in this study, it turned out that 14 of the fields responded to phosphate as well as potash.

There are numerous phosphate-deficient soils, on the other hand, which do not require potash fertilization. This is borne out by summaries of soil-test results on samples submitted by farmers as well as by field experimental results.

With some experiments carried out

on soils deficient in both phosphate and potash, 300 pounds of 0-20-20 per acre appeared to be the most profitable rate for topdressing. On a few soils, such as the Carrington loam in Buchanan County (see chart), a higher rate was very profitable. In other experiments where significant responses to potash of about ¼ ton per acre or less occurred along with appreciable responses to phosphate, it is probable that 300 pounds of 0-20-10 per acre would have given more profitable returns from use of potash. In our experiments, the lowest rate used was 100 pounds of 0-0-60 per acre.

Carry-over of Phosphate and Potash

Increased hay yields for one year tell only part of the story on what to expect from topdressing with phosphate or potash fertilizers. The carry-over or residual effects will likely turn out to be important, especially with phosphate fertilizers. Some of the results obtained last year on meadows topdressed with 300 pounds of 0-20-0 in 1949 bear this out. In one case the hay increase was 1,200 pounds in 1949 and about the same from residual phosphorus in 1950. In certain experiments, there was no carry-over from the same rate of application.

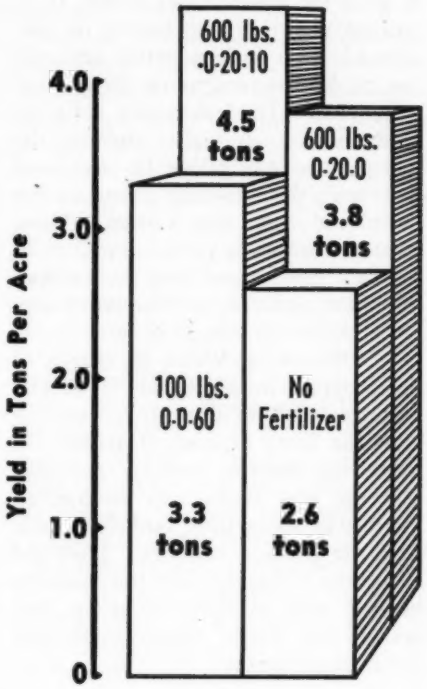
Carry-over of potash is another question. If a meadow receives more potash than it needs, legume and grass will take up more of this nutrient than is required. Taking off a hay crop removes an excessive amount of potash. If this hay is fed on the farm much of this potash may be returned to the soil in manure.

Time to Topdress

An early spring topdressing (late March or early April) has given good results in Iowa experiments. Usually larger responses to both phosphate and potash have occurred with the first cutting than with subsequent cuttings. In some of the eastern states, good results apparently have been obtained from topdressing potash between the first and second cuttings. Moisture conditions in Iowa often are more favorable before the first hay harvest than in the following months, whereas in eastern United States there is relatively a more uniform seasonal distribution of rainfall. This may account for the differences noted above in response of legumes to potash topdressings.

There's still plenty to be learned about time, method, and frequency of phosphate and potash application. For the present the important thing to remember is this: Use a topdressing if soil tests show a need for phosphate or potash. But don't try to make it a substitute for fertilization at seeding time.

Meadow Response to Phosphate and Potash (Buchanan County)



Research Boosts Soy Prospects

IN their efforts to meet production goals for soybeans this season, U. S. farmers will have the benefit of considerable help from scientific research, the U. S. Department of Agriculture points out. The emergency calls for production much higher than in the first years of World War II. But since that time the breeding program has introduced eight new varities. These improved soybeans yield from 10 to 20 per cent more beans than the varieties they have replaced, and the beans supply a higher percentage of oil.

Dr. Martin G. Weiss, in charge of the program in which the U. S. Department of Agriculture is cooperating with the State experiment stations in improving soybean varieties, estimates that the new beans will average an increase of about three bushels an acre over the pre-war varieties. They are also easier to harvest with the combine, because most of them stand up well and do not "lodge" when loaded with the matured beans.

Blackhawk is the latest of the eight to be released, and there was not seed enough this year to supply all the farmers who would have liked to plant it. The other seven have been out long enough so that there are ample supplies of the seed of each to plant the acreage for which each is best adapted. These varieties are named: Hawkeye; Adams; Lincoln; Wabash; Monroe; Ogden; and Roanoke.

Research has also proved the economy of closer planting of soybeans, has worked out fertilizer applications for some areas where deficiencies of certain minor plant nutrients have cut yields, and is now breeding soybeans resistant to some of the diseases that attack the crop. So far, diseases have not been serious on a wide scale.

The breeding program got under way in 1936 and is continuing. Successful research accounts in large measure for the rapid rise in the importance of soybeans as a crop. In the United States it now ranks as fifth in importance.

Upward Trend in Cotton

AMERICAN cotton growers in recent years have been harvesting as much cotton from 160 acres as they did from 270 acres a quarter of a century ago—or as they did in the 1870's—U. S. Department of Agriculture records indicate. This is revealed by the "trend yield" record of cotton. The "trend yield" is one of the interesting and important devices by which the statisticians average out the seasonal effect of weather and get a measure of long time-developments in production of the crop.

The "trend yield" for any given year is the actual average yield per acre for the year averaged with the corresponding figure for the four crops preceeding and the four following. Thus the latest year for which the Bureau of Agricultural Economics has a "trend" figure is 1946. When the 1951 yield is known the "trend yield" for 1947 can be added.

From 1870 to 1917 there was a gradual upward trend, from about 160 pounds an acre to about 175 in 1917. Then came the boll weevil. The trend dipped sharply, and in 1925 had lost the previous gains and was slightly below the 160-pound mark of 1870.

Since 1925 the trend has been sharply upward, and the latest figure (for 1946) registers 271 pounds, an increase in average yield of more than 100 pounds to the acre since 1925. "This steady rise," says the Bureau, "was undoubtedly due to improved varieties of cotton, better production methods, and shifts to cotton arcreage in new areas."

Seek Hard Shell Volunteers

SEEDS with hard shells have generally been regarded as a nuisance, whether the plant was a crop or a weed. But nowadays soil conservation specialists of the U. S. Department of Agriculture are actually searching for harder shelled strains in several plant families. Harder shells would be useful in plants grown for winter ground covers.

As any farmer knows, hardness of the bindweed's shell is one of the reasons this serious weed pest is so hard to eradicate. New plants will keep sprouting for years after old plants have been killed. So it is, also, with useful crop seeds.

Popularity of hard-shelled "reseeding crimson clover" in Southern orchards, pastures, and crop lands is a result of its volunteering. It does reseed. But if it is turned under in spring for green manure before seeds ripen, there is little reseeding. The Caley pea, a winter legume, has some excellent qualities, and is a good reseeder because of its hard shell seeds. If a farmer allows one crop of Caley peas to ripen seed before plowing it under, he has a reserve of reseeding power for another year or two. Seeds lie dormant in summer, some sprout and grow in early fall; and others wait a year or more longer and thus provide continuing and more dependable ground protection. Button clover also has hard seeds and volunteers well.

At their seed nurseries, Soil Conservation Service specialists are alert to the need for better strains of ground cover plants that seed well and are easy to harvest. They are now also watching for strains of clovers, vetches, peas, and other legumes that have a high proportion of hard seeds that make them better reseeders. These could be used in rotations that allow a farmer to plow under a seed crop every few years with the expectation of having volunteer soil savers for the next season or longer.

To improve the initial stand from a seeding of sweetclover, farmers "scarify" the seed so that more plants will germinate promptly instead of lying dormant for a year or more. Likewise, in an original planting of Caley peas, "scarification" may be needed.

In humid areas, a winter ground cover can be a great soil saver when planted after the last cultivation of a row crop—corn, cotton, tobacco. It protects the soil. If plowed under as green manure it improves soil tilth. If the cover crop is a legume, it also supplies some nitrogen and eases the fertilizer bill. And if it reseeds well, the grower is spared the cost and labor of replanting. Hard-shell reseeders are worth watching for.

Productive Balance

RESEARCH on the use of fertilizers and methods of soil management have revealed facts that aid farmers to make specific soils more productive, says P. V. Cardon, Administrator of Agricultural Research in the U. S. Department of Agriculture. Because techniques based on this research have been put to use on many farms throughout the country, productivity is on the come-back in many areas where yields were falling off because of declining soil fertility. On hundreds of thousands of farms in the eastern part of the United States, the soil is much better today, as a result of good management, than it ever was under natural conditions. On the other hand, there are still many farms on which soil productivity is on the down grade. For the Nation generally, he says, we have not yet fully reversed the downward trend.

Know Your Soil . . .

(*From page* 14)

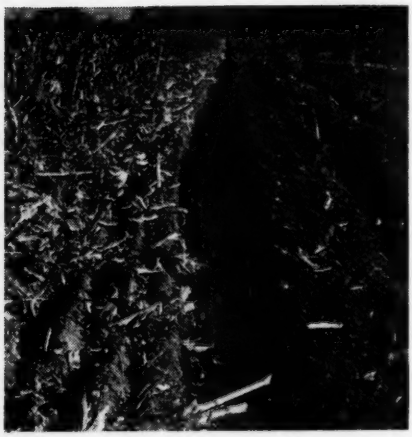


Fig. 5. Corn fodder being returned to the soil to increase organic matter.

produce better than 100 bushels of corn per acre, 40 bushels of wheat, and 70 bushels of barley on this soil. With this production it is possible to add considerable organic matter to the soil if only the grain is removed. Figure 4 shows the corn that produced better than 100 bushels of corn per acre as the result of the use of 300 pounds of a 5-10-10 fertilizer at planting time, 300 pounds of cyanamid immediately after planting, and 300 pounds of ammonium nitrate at the "knee-high" stage with a population of 15,000 stalks per acre. Of course, this crop followed a 15-ton tomato crop which was limed to a pH value better than 6.2 and fertilized with 1,500 pounds of a 5-10-10 fertilizer mixture.

Figure 5 shows the organic matter from the corn crop being returned to the soil. This organic matter is very essential to the Woodstown sandy loam. It increases the number of favorable aerobic micro-organisms, the aeration, and the drainage.

It becomes evident from the experimentation and observations discussed above that the Woodstown sandy loam, if properly managed, can become an important agricultural and vegetable-producing soil. Carefully considered and practical handling, liming, and fertilization of this soil place it in a productive category.

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The Man With the "Know"

(*From page* 5)

those years also in citrus fruit culture and breeding, and the selective way in which different strains of stem rust attack the varieties of wheat.

Then in 1920 the federal plant scientists discovered that length of daylight controls flowering and seed setting in many kinds of plants. Soon thereafter you saw night lights burning in greenhouses at your nearest experiment farm, and thought the professors were crazy to waste so much funds on electric lights. This was the year, too, when soilsmen found a way to study soil profiles as the best way to classify the land's varied types. In 1922 the first

agreements were drawn up to link the state and the federal breeders in developing promising inbred lines for hybrid seed corn.

As a plugging writer in that period, it was my stuttering attempts to learn about crossed corn that brought the early work of breeders in a leading Midwest state more clearly before the farmers. Gone would be all our old ideas about curing seed corn on the farm from plump, well-filled ears, imitating the best-formed ones we saw at the winter shows. That line of herculanian research from meager and misunderstood beginnings — fraught with complex genetic rules—has probably achieved the greatest single agrarian revolution in our time. It has made men rich on farms and given the "cloistered breeders" secret joy and pride of personal achievement in being able to help their day and age for a program of peace and plenty.

One might go on at tiresome length reciting all the forward steps taken in research projects, but wearying readers is bad medicine for selling any kind of proposition. It's enough to observe that even during the past two years such innovations as methods for preparation of radioactive phosphates have been launched and the tracer techniques improved. There has been cooperative work in propagating better foundation stocks of grasses and legumes, and a hybrid strain of guayule originated with nearly 50 per cent more rubber content.

Most fascinating of the wonders wrought by plant chemists and others are the new uses perfected for old denizens of our plant world. It is in this realm, bounded on one side by training and skill and on the other by lofty imagination and resolve, that race and creed and color vanish—and all men meet as equals for their own salvation.

Here is the field where that noted black man, George Washington Carver, contributed with such industry and zeal. He was the first research director at Tuskegee Institute, and the laboratories under his command fashioned an amazing list of useful things from Alabama clay, peanuts, sweet potatoes, and cotton. Congress has finally deposited requisite funds to set up a memorial monument to Carver's work. As an infant, he was kidnapped during a raid incidental to the war of 1860-65, but after a long period of silence, he emerged with two academic degrees at Iowa State College, and soon pressed on to become a foremost rescuer of his land from a tedious and pauperizing one-crop agriculture.

Moreover, a life such as his has inspired many more of his race to uplift their ambitions and train themselves to work unceasingly for the common good. It has also taught boys and girls of all races that America still affords a great opportunity to those with foresight, industry, and imagination—always and forever *imagination.* The imagination of the scientist exceeds in its final contribution to humanity all the flights of fancy and of plot which grace the talents of the novelist and the poet.

IN the transformation of the fibers and proteins and acids of plants and their residues into some new commodity of value, corn may head the list for all we know. It represents one of the older examples of these magical tricks of legerdemain—but it is not by any means the most outstanding. Usually these new uses emerge whenever a product gets so common and abundant that growers find their outlets blocked or limited. So we can turn to citrus groves for another sample of what's been going on in offering the public something made from overly abundant plant life.

From Clyde Beale of the Florida Agricultural Extension Service comes a brief tale of a mighty piece of salvage work. He says that when the orange is served fresh, the peelings and the "rag" are wasted. But when the modern processing plant handles the

NO_3 P K pH Fe Mg Na Al

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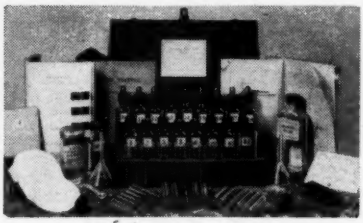
SOIL TESTING



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orange crop, the first simple steps provide us with candied peel, marmalade, cattle feed, juice for beverages, sliced sections for canning, powdered and frozen concentrates, an oil for use in soaps and perfumes, and orange wine. However, this is just getting the process steamed up, as it were. More magic is forthcoming when chemists really try to unlock and divide and stew up this fruit for what it's worth. Oranges and other citrus products are now able to give us methane fuel gas, citric acid, vitamin C or ascorbic acid, flavoring oils, feed molasses, dry pulp for vitamin P, pectin, naringin—a medicinal and beverage element—candy, pectin-albedo for colitis sufferers, seed cake for cattle, and hulls for both feed and fertilizer. This just trots out the tricks for one product only in the vast scale of the plant drama now unfolding.

Some such alleviating transformations are in the making, too, for countless other specialized farm industries. Along with them also go the studies made under the Research and Marketing Act of 1946, to relieve and improve and refine many purely commercial, manual, and economic movements related to the complex field of processing and selling.

Now all these successful programs in the agricultural and livestock realms were made originally, and for a long time singly, by researchers trained and employed at public expense. There is no doubt whatever about the origin and the stimulus involved. It was started and kept alive by legislatures and Congress, at the suggestion of college and university men whose achievements were so startling and valuable that even the skeptics were "sold." Slowly, and then at a faster clip, we saw wealthy and businesslike corporations with farm interests begin to set up private laboratories. They could do much of that kind of investigating without standing in the glare of public payroll scrutiny. They wanted to do it also for their own financial security.

From this initial urge it was only a step to the more recent building of powerful foundations. These are of at least two kinds — the quasi-public ones set up by alumni and their allies at larger colleges, and the trusts and foundations in memory of noted industrialists. Here then we behold a surge of mental volleys fired at the same targets as the experiment stations aimed at with considerable "haggling" over appropriations. Now comes a new idea besides. A Southern state has set a date next November in which their farmers are invited to vote on the taxing of small sums on the tonnage sales of fertilizer, and using the income for soil research. To cause farmers to willingly accept some of the financial responsibility for carrying on basic research seems to be logical. But less than 20 years ago any such idea would have entitled the one who hatched it to spend his last days in the dog-house.

Yes, farmers of this day and age are a different "breed of cats" in matters of science applied to humdrum tasks. They do not claim to know what it all means. They can't usually talk the lingo clearly. Yet they have found that brains count as much as the weather in making or marring a season's effort.

Bear in mind, that in the immediately preceding thought I did not mean that the younger generation could not speak and understand the language of the test tube and the microscope. I referred to their elders. As it stands now I never try to converse very deeply with the modern youth of farm origin over the intricate terms and aims of plant science. Like all smart alecs with some false pride, I know when to refrain and not get tangled up in technique. All I do is grin and nod and applaud and exclaim that the "good old world do move indeed."

So when I go afield again to peer around in hopes of discovering a man with the hoe, bent over some weary chore, my search is unrewarded. Even in the old, weed-infested, hard-pan,

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brush-covered zones of my youth there are hoe-wielding gentry no more.

I find them still in suburban garden patches, it's true, and I presume they do exist on southern hillsides of remote location. Yet in the garden plots of urban striving, the hoe is not the sacred, single, and indispensable tool it once became. Palm callouses from grasping hoe handles are not so generally used in proof of outdoor aboreal craftsmanship. Our happy garden delvers have seen the wonders of the new universe of plant coaxing and soil renewal. Their stocks of DDT, lindane, toxaphene and chlordane, 2, 4-D, and kindred accoutrements are making them partners with the progress of the farm. Maybe this makes them aware that farming is expensive and meticulous and skillful. Maybe the consumers thus fortified with personal experience in buying garden supplies will realize that farm work is a science, and a close kin to scientific procedure. Maybe this will help undue a lot of spoiled bolony which newspapers and magazines have been serving to city readers.

At any rate, I am foolishly happy as the elder years draw nigh because I have been spared to behold the new day in agriculture. If destiny decrees that farmers must be commercial and businesslike to succeed, instead of being hawk-hunting hermits, I am for giving them all the new tools and methods necessary. I don't want my three grandchildren to suffer either from underfed bellies or prejudiced ideas about agriculture.

If they are to get the right food in proper variety and quality, I expect them to appreciate what it costs to serve them well and why. And above all, they will find out that research and improvement all through the farming business will cut the loss and overhead as far as the production goes. What happens in the market place and among the middlemen is another line of investigation entirely. We can only hope that science will get around to that job soon.

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Clerk to young man buying perfume: "Now here's one called 'Perhaps.' It's $35 an ounce."

"Thirty-five dollars!" exclaimed the young man. "For $35 I don't want 'perhaps,' I want 'sure.' "

* * *

"My boy," said the successful man lecturing his son on the importance of thrift, "when I was your age I carried water for a gang of bricklayers."

"I'm proud of you, father," answered the boy. "If it hadn't been for your pluck and perseverance, I might have had to do something of that sort myself."

* * *

A girl applied for a job as a stenographer and they gave her a test in spelling.

"How do you spell Mississippi?" she was asked.

"The river or the state?"

* * *

Yes, life begins at forty. Also arthritis, stomach ulcers, bifocals, bellyache, gall bladder, colic, hay fever, toothache, and an inclination to talk continuously about the good old days.

* * *

A six-year-old was getting ready for his first day of school, and his mother was very sad at the thought of her baby growing up and leaving her every day.

As they drove toward the school, the child turned to his mother consolingly. "Don't take it so hard, Mom. Just as soon as I learn to read the comics by myself, I'll quit."

Mandy was in the hospital having a baby. She kept screaming and screaming. Finally a doctor came up to her and said, "Mandy, there is no need to scream so loud—if you would concentrate more you wouldn't scream so much." She paid no attention to the doctor and kept right on screaming. Suddenly she stopped.

Mandy—"Is Jasper still downstairs?"

Doctor—"Yes, he is downstairs pacing the floor."

Mandy—"Well, you go right down and tell him that if this is a sample of married life—I don't even want to be engaged."

* * *

The shapely co-ed's sweater was much too tight, and the rest of her debate was drowned out by loud laughter when she stood before the class and started off with: "Now there are just two interesting points I'd like to bring out."

* * *

A mother was instructing her young son in table manners just before he was to leave for a party at the home of one of his little friends.

Mother—"Now, Junior, if you're offered a second piece of cake, be a little gentleman and refuse, just as nicely as your father does."

When the boy returned home after the party, his mother asked:

Mother—"Did you refuse the second piece of cake, as I told you to?"

Junior—"Sure, mother, just like father does. I said: 'Take the damned stuff out of my sight!' "

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